



# THE ATMOSPHERIC RESERVOIR

*Examining the Atmosphere and Atmospheric Resource Management*

## When do seasons officially change?

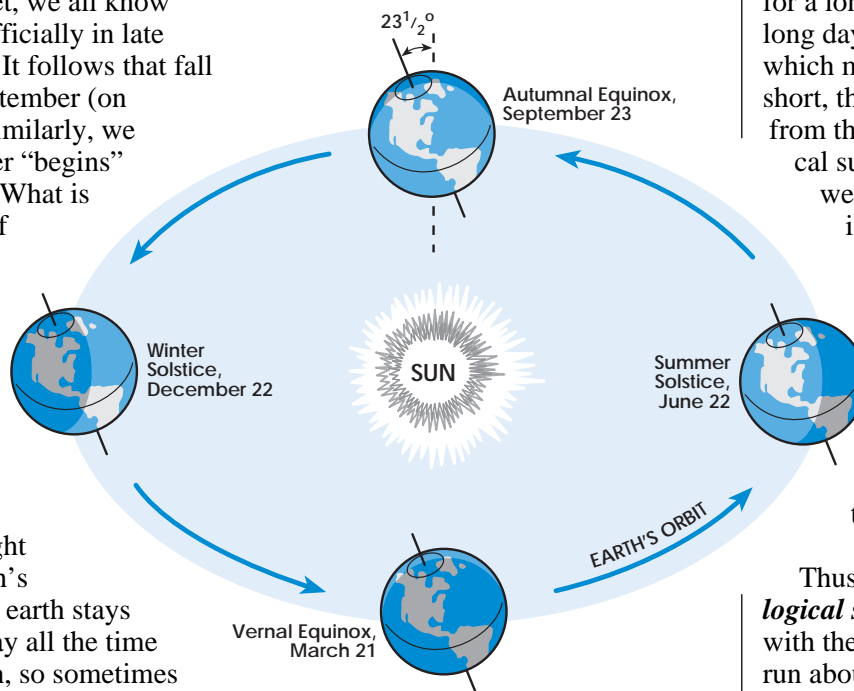
by Bruce Boe

It begins in mid-August, with the back-to-school talk. We hear it everywhere: summer is ending, and fall beginning. Yet, we all know summer begins officially in late June; on June 21. It follows that fall begins in late September (on September 23). Similarly, we are told that winter "begins" on December 22. What is the significance of these dates?

We have seasons because the earth's axis of rotation is tilted  $23\frac{1}{2}$  degrees from what would be considered "straight up" from the earth's orbital plane. The earth stays tilted the same way all the time as it orbits the sun, so sometimes the northern hemisphere (NH) is tilted away from the sun (winter), and half a year later, toward the sun (summer). Halfway between winter and summer, the earth is still tilted, but neither toward nor away from the sun. Instead, the earth is tilted along the direction it is traveling.

These four points along each orbit (year) define what is known as the **astronomical seasons**. This year, on June 21, the earth's NH was tilted the full  $23\frac{1}{2}$  degrees towards the sun. Thus, for any place located at  $23.5$  degrees north latitude, the sun was directly overhead. At this time, the days are as long as they will get, anywhere in the NH. At locations

north of  $66.5$  degrees north latitude (the Arctic Circle), the sun never sets! This date, called the **summer solstice**, marks the beginning of **astronomical summer**.



As the earth continues in its orbit (year), it tilts less toward the sun, and more and more along the direction of motion. This makes the days shorter, and the nights longer. On one day, the day and night are of equal length. This is the **autumnal (fall) equinox**, which occurs on September 23. The autumnal equinox marks the end of astronomical summer, and the beginning of **astronomical fall**. Similarly, the **winter solstice**, when the NH is tilted the maximum away from the sun, marks the beginning of **astronomical winter**. So why does our weather not match up very well with our seasons?

The answer is straightforward. Though the summer solstice has the most daylight of the year, and marks the beginning of astronomical summer, the days are quite lengthy for a long time before the solstice. A long day means a lot of sunshine, which means a lot of warmth. In short, the earth gets a lot of energy from the sun well before astronomical summer. If we think about it, we realize that the length of day is the same on May 21 as it is on July 21. We are usually much warmer on July 21 only because during May, the earth is still warming after a long cold winter. Likewise, we're usually much colder on January 22 than on November 22.

Thus, we see that our **meteorological seasons**, are not in phase with the astronomical seasons, but run about a month ahead. Because of our 12-month calendar, we find it easy to include all of June in "summer", all of September in "fall", all of December in "winter", and all of March in "spring". Maybe the next time somebody refers to the next season as starting sooner than you like, you'll say, "Not so fast! Astronomical (*insert the season here*) doesn't begin for another three weeks!" ■

Atmospheric Resource Board  
North Dakota State Water Commission  
900 East Boulevard, Bismarck, ND 58505  
701) 328-2788  
Internet: <http://www.swc.state.nd.us/ARB/>  
ND Weather Modification Association  
PO Box 2599, Bismarck, ND 58502  
701) 223-4232